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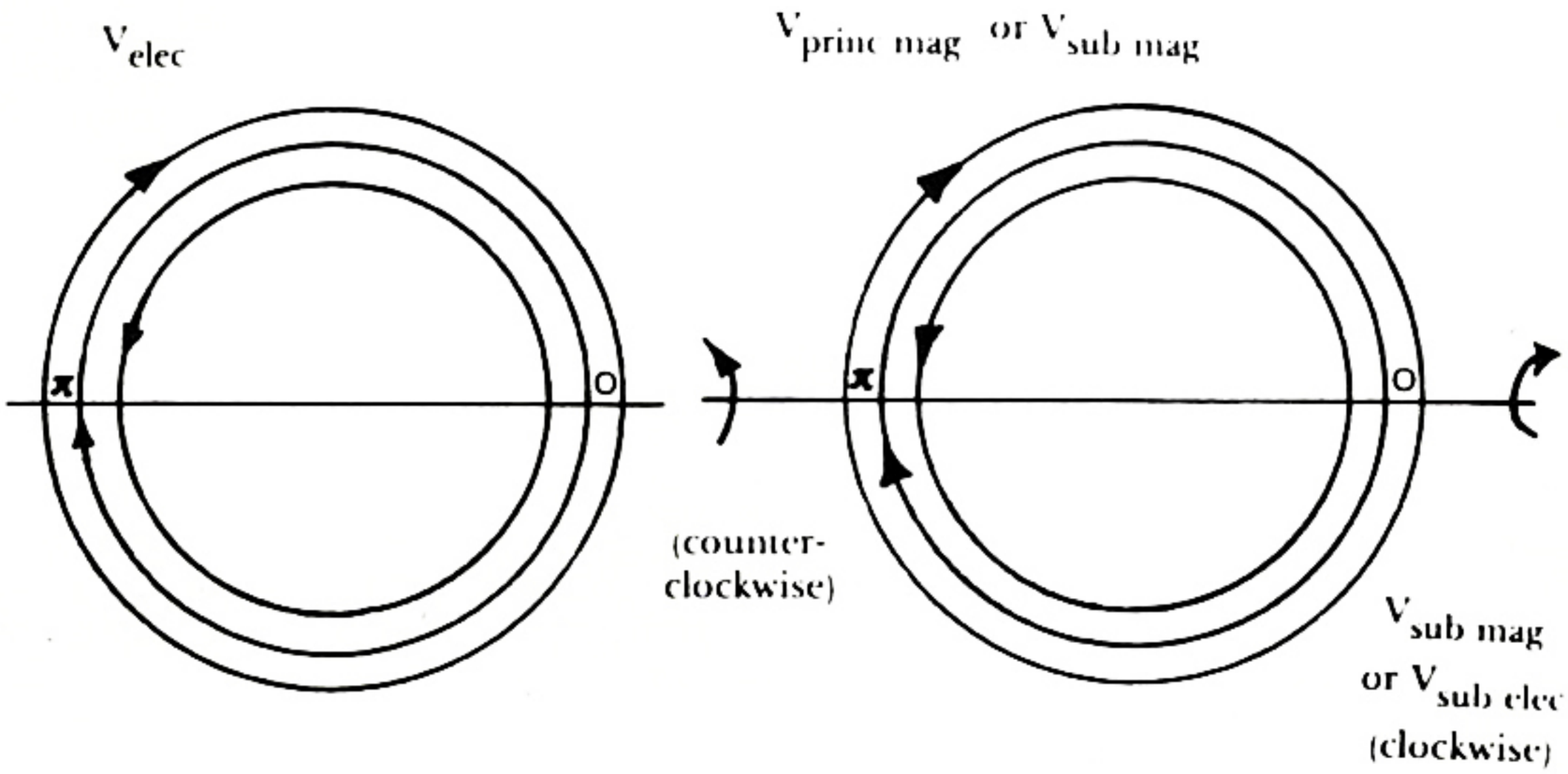

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TABLE OF CONTENTS

A PROPOSAL FOR A CRUCIAL EXPERIMENT.....3
by Ronald W. Satz

SOLID COHESION with Preface to BASIC PROPERTIES OF MATTER...4
by Dewey B. Larson

We begin the serialization of Dewey B. Larson's Basic Properties of Matter, the second volume of a revised and enlarged edition of The Structure of the Physical Universe (1959).

PHOTOIONIZATION AND PHOTOMAGNETIZATION.....1.
by Ronald W. Satz

Both Quantum Mechanics and the Reciprocal System attempt to explain the two phenomena. Which is more in agreement with observations?

ARE COSMIC RAY PROTONS PRIMARY?.....35
by Frank H. Meyer

A new discovery confirms a prediction of the Reciprocal System.

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A PROPOSAL FOR A CRUCIAL EXPERIMENT

by Ronald W. Satz

Rutherford's nuclear theory of the atom has held sway in the scientific community for 70 years. I now propose a test which may disprove it. In the original scattering experiment, charged helium atoms (alpha particles) were beamed at a gold foil; the resultant scattering was claimed to be due to Coulombic repulsion by charged nuclei. Now suppose that that non-charged helium atoms are beamed at a gold foil. The Reciprocal System of Theory predicts the same scattering in this case. The Rutherford theory predicts no scattering.

Of course, experimenting with non-charged helium atoms is more difficult than with charged ones. The scattering apparatus will have to incorporate a means to inject electrons to neutralize the alpha particles and a different material to detect the particles after scattering.

Numerous physics laboratories in the world have the capability to carry out this experiment. Which will be the first?

Preface to BASIC PROPERTIES OF MATTER

by Dewey B. Larson

This volume is the second in a series in which I am undertaking to develop the consequences that necessarily follow if it is postulated that the physical universe is composed entirely of motion. The characteristics of the basic motion were defined in Nothing But Motion, the first volume of the series, in the form of seven assumptions as to the nature and interrelation of space and time. In the subsequent development, the necessary consequences of these assumptions have been derived by logical and mathematical processes without the introduction of any supplementary or subsidiary assumptions, and without introducing anything from experience. Coincidentally with this theoretical development, it has been shown that the conclusions thus reached are consistent with the relevant data from observation and experiment, wherever a comparison can be made. This justifies the assertion that, to the extent to which the development has been carried, the theoretical results constitute a true and accurate picture of the actual physical universe.

In a theoretical development of this nature, starting from a postulate as to the fundamental nature of the universe, the first results of the deductive process necessarily take the form of conclusions of a basic character: the structure of matter, the nature of electromagnetic radiation, etc. Inasmuch as these are items that cannot be apprehended directly, it has been possible for previous investigators to formulate theories of an ad hoc nature in each individual field to fit the limited, and mainly indirect, information that is available. The best that a correct theory can do in any one of these individual areas is to arrive at results that also agree with the available empirical information. It is not possible, therefore, to grasp the full significance of the new devlopment unless it is recognized that the new theoretical system, the Reciprocal System, as we call it, is one of general application, one that reaches all of its conclusions in all physical fields by deduction from the same set of basic premises.

Experience has indicated that it is difficult for most individuals to get a broad enough view of the fundamentals of the many different branches of physical science for a full appreciation of the unitary character of this new system. However, as the deductive development is continued, it gradually extends down into the more familiar areas, where

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the empirical information is more readily available, and less subject to arbitrary adjustment or interpretation to fit the prevailing theories. Thus the farther the development of this new general physical theory is carried, the more evident its validity becomes. This is particularly true where, as in the subject matter treated in this present volume, the theoretical deductions provide both explanations and numerical values in areas where neither is available from conventional sources.

SOLID COHESION

The consequences of the reversal of direction (in the context of a fixed reference system) that takes place at unit distance were explained in a general way in chapter 8 of Volume I. As brought out there, the most significant of these consequences is that establishment of an equilibrium between gravitation and the progression of the natural reference system becomes possible.

There is a location outside unit distance where the magnitudes of these two motions are equal: the distance that we are calling the gravitational limit. But this point of equality is not a point of equilibrium. On the contrary, it is a point of instability. If there is even a slight unbalance of forces one way or the other, the resulting motion accentuates the unbalance. A small inward movement, for instance, strengthens the inward force of gravitation, and thereby causes still further movement in the same direction. Similarly, if small outward movement occurs, this weakens the gravitational force and causes further outward movement. Thus, even though the inward and outward motions are equal at the gravitational limit, this is actually nothing but a point of demarcation between inward and outward motion. It is not a point of equilibrium.

In the region inside unit distance, on the contrary, the effect of any change in position opposes the unbalanced forces that produced the change. If there is an excess gravitational force, an outward motion occurs which weakens and eliminates the unbalance. If the gravitational force is not adequate to maintain a balance, an inward motion takes place. This increases the gravitational effect and restores the equilibrium. Unless there is some intervention by external forces, atoms move gravitationally until they eventually come within unit distance of other atoms. Equilibrium is then established at positions within this inside region: the time region, as we have called it.

The condition in which a number of atoms occupy equilibrium positions of this kind in an aggregate is known

as the solid state of matter. The distance between such positions is the inter-atomic distance, a distinctive feature of each particular material substance that we will examine in detail in the following chapter. Displacement of the equilibrium in either direction can be accomplished only by the application of a force of some kind, and a solid structure resists either an inward force, a compression, or an outward force, a tension. To the extent that resistance to tension operates to prevent separation of the atoms of a solid it is commonly known as the force of cohesion.

The conclusions with respect to the nature and origin of atomic cohesion that have been reached in this work replace a familiar theory, based on altogether different premises. This previously accepted hypothesis, the electrical theory of matter, has already had some consideration in the preceding volume, but since the new explanation of the nature of the cohesive force is basic to the present development, some more extensive comparisons of the two conflicting viewpoints will be in order before we proceed to develop the new theoretical structure in greater detail.

The electrical, or electronic, theory postulates that the atoms of solid matter are electrically charged, and that their cohesion is due to the attraction between unlike charges. The principal support for the theory comes from the behavior of ionic compounds in solution. A certain proportion of the molecules of such compounds split up, or dissociate, into oppositely charged components which are then called ions. The presence of the charges can be explained in either of two ways: (1) the charges were present, but undetectable, in the undissolved material, or (2) they were created in the solution process. The adherents of the electrical theory base it on explanation (1). At the time this explanation was originally formulated, electric charges were thought to be relatively permanent entities, and the conclusion with respect to their role in the solution process was therefore quite in keeping with contemporary scientific thought. In the meantime, however, it has been found that electric charges are easily created and easily destroyed, and are no more than a transient feature of matter. This cuts the ground from under the main support of the electrical theory, but the theory has persisted because of the lack of any available alternative.

Obviously some kind of a force must hold the solid aggregate together. Outside of the forces known to result directly from the observable motion, there are only three kinds of force of which there has heretofore been any definite observational knowledge: gravitational, electric and magnetic. The so-called "forces" which play various roles in present-day atomic physics are purely hypothetical. Of the

three known forces, the only one that appears to be strong enough to account for the cohesion of solids is the electric force. The general tendency in scientific circles has therefore been to take the stand that cohesion must result from the operation of electrical forces, notwithstanding the lack of any corroboration of the conclusions reached on the basis of the solution process, and the existence of strong evidence against the validity of those conclusions.

One of the serious objections to this electrical theory of cohesion is that it is not actually a theory, but a patchwork collection of theories. A number of different explanations are advanced for what is, to all appearances, the same problem. In its basic form, the theory is applicable only to a restricted class of substances, the so-called "ionic" compounds. But the great majority of compounds are "non-ionic." Where the hypothetical ions are clearly non-existent, an electrical force between ions cannot be called upon to explain the cohesion, so, as one of the general chemistry tests on the author's shelves puts it, "A different theory was required to account for the formation of these compounds." But this "different theory," based on the weird concept of electrons "shared" by the interacting atoms, is still not adequate to deal with all of the non-ionic compounds, and a variety of additional explanations are called upon to fill the gaps.

In current chemical parlance the necessity of admitting that each of these different explanations is actualy another theory of cohesion is avoided by calling them different types of "bonds" between the atoms. The hypothetical bonds are then described in terms of interaction of electrons, so that the theories are united in language, even though widely divergent in content. As noted in Chapter 19, Vol. I, a half dozen or so different types of bonds have been postulated, together with "hybrid" bonds which combine features of the general types.

Even with all of this latitude for additional assumptions and hypotheses, some substances, notably the metals, cannot be accomodated within the theory by any expedient thus far devised. The metals admittedly do not contain oppositely charged components, if they contain any charged components at all, yet they are subject to cohesive forces that are indistinguishable from those of the ionic compounds. As one prominent physicist, V. F. Weisskopf, found it necessary to admit in the course of a lecture, "I must warn you I do not understand why metals hold together." Weisskopf points out that scientists cannot even agree as to the manner in which the theory should be applied. Physicists give us one answer, he says, chemists another, but "neither of these answers is adequate to explain what a chemical bond is."[1]

This is a significant point. The fact that the cohesion of metals is clearly due to something other than the attraction between unlike charges logically leads to a rather strong presumption that atomic cohesion in general is non-electrical. As long as some non-electrical explanation of the cohesion of metals has to be found, it is reasonable to expect that this explanation will be found applicable to other substances as well. Experience in dealing with cohesion of metals thus definitely foreshadows the kind of conclusions that have been reached in the development of the Reciprocal System of theory.

It should also be noted that the electrical theory is entirely ad hoc. Aside from what little support it can derive from extrapolation to the solid state of the conditions existing in solutions, there is no independent confirmation of any of the principal assumptions of the theory. No observational indication of the existence of electrical charges in ordinary matter can be detected, even in the most strongly ionic compounds. The existence of electrons as constituents of atoms is purely hypothetical. The assumption that the reluctance of the inert gases to enter into chemical compounds is an indication that their structure is a particularly stable one is wholly gratuitous. And even the originators of the idea of "sharing" electrons make no attempt to provide any meaningful explanation of what this means, or how it could be accomplished, if there actually were any electrons in the atomic structure. These are the assumptions on which the theory is based, and they are entirely without empirical support. Nor is there any solid basis for what little theoretical foundation the theory may claim, inasmuch as its theoretical ties are to the nuclear theory of atomic structure, which is itself entirely ad hoc.

But these points, serious as they are, can only be regarded as supplementary evidence, as there is one fatal weakness of the electrical theory that would demolish it even if nothing else of an adverse nature were known. This is our knowledge of the behavior of positive and negative electric charges when they are brought into close proximity. Such charges do not establish an equilibrium of the kind postulated in the theory; they destroy each other. There is no evidence which would indicate that the result of such contact is any different in a solid aggregate, nor is there even any plausible theory as to why any different outcome could be expected, or how it could be accomplished.

It is worth noting in this connection that while current physical theory portrays positive and negative charges as existing in a state of congenial companionship in the nuclear theory of the atom and in the electrical theory of matter, it

turns around and gives us explanations of the behavior of antimatter in which these charges display the same violent antagonism that they demonstrate to actual observation. This is the kind of inconsistency that inevitably results when recalcitrant problems are "solved" by ad hoc assumptions that involve departures from established physical laws and principles.

In the context of the present situation in which the electrical theory is challenged by a new development, all of these deficiencies and contradictions that are inherent in the electrical theory become very significant. But the positive evidence in favor of the new theory is even more conclusive than the negative evidence against its predecessor. First, and probably the most important, is the fact that we are not replacing the electrical theory of matter with another "theory of matter." The Reciprocal System is a complete general theory of the physical universe. It contains no hypotheses other than those relating to the nature of space and time, and it produces an explanation of the cohesion of solids in the same way that it derives logical and consistent explanations of other physical phenomena: simply by developing the consequences of the basic postulates. We therefore do not have to call upon any additional force of a hypothetical nature to account for the cohesion. The two forces that determine the course of events in the region outside unit distance also account for the existence of the inter-atomic equilibrium inside this distance.

It is significant that the new theory identifies both these forces. One of the major defects of the electrical theory of cohesion is that it provides only one force, the hypothetical electrical force of attraction, whereas two forces are required to explain the observed situation. Originally it was assumed that the atoms are impenetrable, and that the electrical forces merely hold them in contact. Present-day knowledge of compressibility and other properties of solids has demolished this hypothesis, and it is now evident that there must be what Karl Darrow called an "antagonist," in the statement quoted in Volume I, to counter the attractive force, whatever it may be, and produce an equilibrium. Physicists have heretofore been unable to find any such force, but the development of the Reciprocal system has now revealed the existence of a powerful and omnipresent force hitherto unknown to science. Here is the missing ingredient in the physical situation, the force that not only explains the cohesion of solid matter, but, as we saw in Volume I, supplies the answers to such seemingly far removed problems as the structure of star clusters and the recession of the galaxies.

One point that should be specifically noted is that it is this hitherto unknown force, the force due to the progression of the natural reference system, that holds the solid aggregate together, not gravitation, which acts in the opposite direction in the time region. The prevailing opinion that the force of gravitation is too weak to account for the cohesion is therefore irrelevant, whether it is correct or not.

Inasmuch as the new theoretical system applies the same general principles to an understanding of all of the inter-atomic and inter-molecular equilibria, it explains the cohesion of all substances by the same physical mechanism. It is no longer necessary to have one theory for ionic substances, several more for those that are non-ionic, and to leave the metals out in the cold without any applicable theory. The theoretical findings with respect to the nature of chemical combinations and the structure of molecules that were outlined in the preceding volume have made a major contribution to this simplification of the cohesion picture, as they have eliminated the need for different kinds of cohesive forces, or "bonds." All that is now required of a theory of cohesion is that it supply an explanation of the inter-atomic equilibrium, and this is provided, for all solid substances under all conditions, by balancing the outward motion (force) of gravitation against the inward motion (force) of the progression of the natural reference system. Because of the asymmetry of the rotational patterns of the atoms of many elements, and the consequent anisotropy of the force distributions, the equilibrium locations vary not only between substances, but also between different orientations of the same substance. Such variations, however, affect only the magnitudes of the various properties of the atoms. The essential character of the inter-atomic equilibrium is always the same.

As indicated in the original discussion of gravitation, even though the various aggregates of matter do not actually exert gravitational forces on each other, the observable results of their gravitational motions are identical with those that would be produced if such forces did exist. The same is true of the results of the progression of the natural reference system. There is a considerable element of convenience in expressing these results in terms of force, on an "as if" basis, and this practice has already been followed to some extent in the previous volume. Now that we are ready to begin a quantitative evaluation of the inter-atomic relations, however, it is desirable to make it clear that the force concept is being used only for convenience. Although the quantitative discussion that follows, like the earlier qualitative discussion, will be carried on in terms of forces, what we will actually be dealing with are the inward

and outward motions of each individual atom.

While the items that have been mentioned add up to a very impressive case in favor of the new theory of cohesion, the strongest confirmation of its validity comes from its ability to locate the point of equilibrium; that is to give us specific values of the inter-atomic distances. As will be demonstrated in Chapter 2, we are already able, by means of the newly established relations, to calculate the possible values of the inter-atomic distance for most of the simpler substances, and there do not appear to be any serious obstacles in the way of extending the calculations to more complex substances whenever the necessary time and effort can be applied to the task. Furthermore, this ability to determine the location of the point of equilibrium is not limited to the simple situation where only the two basic forces are involved. Chapters 4 and 5 will show that the same general principles can also be applied to an evaluation of the changes in the equilibrium distance that result from the application of heat or pressure to the solid aggregate.

Although, as stated in Volume I, the true magnitude of a unit of space is the same everywhere, the effective magnitude of a spatial unit in the time region is reduced by the inter-regional ratio. It is convenient to regard this reduced value, 1/156.44 of the natural unit, as the time region unit of space. The effective portion of a time region phenomenon may extend into one or more additional units, in which case the measured distance will exceed the time region unit, or the original single unit may not be fully effective, in which case the measured distance will be less than the time region unit. Thus the inter-atomic equilibrium may be reached either inside or outside the time region unit of distance, depending on where the outward rotational forces reach equality with the inward force of the progression of the natural reference system. Extension of the inter-atomic distance beyond one time region unit does not take the equilibrium system out of the time region, as the boundary of that region is at one full-sized natural unit of distance, not at one time region unit. So far as the inter-atomic force equilibrium is concerned, therefore, the time region unit of distance does not represent any kind of a critical magnitude.

As we saw in our examination of the composition of the magnetic neutral groups, however, the natural unit as it exists in the time region (the time region unit) is a critical magnitude from the orientation standpoint. An explanation of this difference can be derived from a consideration of the difference in the inherent nature of the two phenomena. Where the inter-atomic distance is less than one time region unit, the rotational forces are acting

against the inward force of the progression of the reference system during only a portion of the unit progression. Similarly, where the inter-atomic distance is greater than one time region unit, the unit inward force is acting against only a portion of the greater-than-unit outward rotational forces. The variations in distance thus reflect differences in the magnitudes of the rotational forces. But the orientation effect has no magnitude. It either exists, or does not exist. As we have noted in the previous discussion, particularly in connection with the structure of the benzene molecule, this effect, if it exists, is the same regardless of whether it acts at short range or at long range. The essential requirement that it must meet is that it must be continuously effective. Otherwise, the orientation is destroyed during the off period. Where the rotational forces extend beyond one time region unit, so that the unit orientation effect is coincident with only a portion of the total rotational forces, the orienting effect is not continuous, and no orientation takes place.

In this chapter we are dealing mainly with what we are calling "rotational forces." These are, of course, the same "as if" forces due to the scalar aspect of the atomic rotation that were called "gravitational" in some other contexts, the choice of language depending on whether it is the origin or the effect of the force that is being emphasized in the discussion. For a quantitative evaluation of the rotational forces we may use the general force equation, providing that we replace the usual terms of the equation with the appropriate time region terms. As explained in introducing the concept of the time region in Chapter 8 of Vol. I, equivalent space $1/t$ replaces space in the time region, and velocity is therefore $1/t^2$. Energy, the one-dimensional equivalent of mass, which takes the place of mass in the time region expression of the force equation, because the three rotations of the atom act separately, rather than jointly, in this region, is the reciprocal of this expression, or t^2. Acceleration is velocity divided by time: $1/t^3$. The time region equivalent of the equation $F = ma$ is therefore $F = Ea = t^2 \times 1/t^3 = 1/t$ in each dimension.

At this point we will need to take note of the nature of the increments of speed displacement in the time region. In the outside region additions to the displacement proceed by units: first one unit, then another similar unit, yet another, and so on, the total up to any specific point being n units. There is no term with the value n. This value appears only as a total. The additions in the time region follow a different mathematical pattern, because in this case only one of the components of motion progresses, the other remaining fixed at the unit value. Here the displacement is $1/x$, and the sequence is $1/1$, $1/2$, $1/3$ . . . $1/n$. The

quantity 1/n is the final term, not the total. To obtain the total that corresponds to n in the outside region it is necessary to integrate the quantity 1/x from x = 1 to x = n. The result is ln n, the natural logarithm of n.

Many readers of the first edition have asked why this total should be an integral rather than a summation. The answer is that we are dealing with a continuous quantity. As pointed out in the introductory chapters of the preceding volume, the motion of which the universe is constructed does not proceed in a succession of jumps. Even though it exists only in units, it is a continuous progression. A unit of this motion is a specific portion of this continuity. A series of units is a more extended segment of that continuity, and its magnitude is an integral. In dealing with the basic individual units of motion in the outside region it is possible to use the summation process, but only because in this case the sum is the same as the integral. To get the total of the 1/x series we must integrate.

To evaluate the rotational force we integrate the quantity 1/t from unity, the physical datum or zero level, to t:

$$F_r = \int_1^t (1/t)\ x\ dt = \ln t \qquad \langle 1\text{-}1 \rangle$$

If the quantity ln t is below unity in any dimension there is no effective outward force in that dimension, but the natural logarithm exceeds unity for all values of x above 2, and the atoms of all elements have a rotational displacement of 2 (equivalent to t = 3) or more in at least one dimension. Consequently, all have effective rotational forces.

The force computed from equation 1-1 is the inherent rotational force of the individual atom; that is, the one-dimensional force which it exerts against a single unit of force. The force between two (apparently) interacting atoms is

$$F = \ln t_A \ln t_B \qquad \langle 1\text{-}2 \rangle$$

For a two-dimensional magnetic rotation this becomes

$$F = \ln^2 t_A \ln^2 t_B \qquad \langle 1\text{-}3 \rangle$$

As we found in Chapter 12, Vol. I, the equivalent of distance s in the time region is s^2, and the gravitational force in this region therefore varies inversely as the fourth power of the distance rather than the square. Applying this factor to the expression for the force of the two-dimensional rotation, together with the inter-regional ratio, the ratio of effective to total force derived in the same chapter, we obtain the effective force of the magnetic rotation of the atom:

$$F_m = (0.006392)^4 \, s^{-4} \, \ln^2 t_A \, \ln^2 t_B \qquad \langle 1\text{-}4 \rangle$$

The distance factor does not apply to the force due to the progression of the natural reference system, as this force is omnipresent, and unlike the rotational force is not altered as the objects to which it is applied change their relative positions. At the point of equilibrium, therefore, the rotational force is equal to the unit force of the progression. Substituting unity for F in equation 1-4, and solving for the equilibrium distance, we obtain

$$s_0 = 0.006392 \, \ln^{1/2} t_A \, \ln^{1/2} t_B \qquad \langle 1\text{-}5 \rangle$$

The inter-atomic distances for those elements which have no electric rotation, the inert gas series, may be calculated directly from this equation. In the elements, however $t_A = t_B$ in most cases, and it will be convenient to express the equation in the simplified form:

$$s_0 = 0.006392 \, \ln t \qquad \langle 1\text{-}6 \rangle$$

The values thus calculated are in the neighborhood of 10^{-8} cm, and for convenience this quantity has been taken as a unit in which to express the inter-atomic and inter-molecular distances. When converted from natural units to this conventional unit, the Angstrom unit, symbol A, equation 1-6 becomes

$$s_0 = 2.914 \, \ln t \, A \qquad \langle 1\text{-}7 \rangle$$

In applying this equation we encounter another of the questions with respect to terminology that inevitably arise in a basically new treatment of any subject. The significance of the quantity t as used in the foregoing discussion and in the equations is obvious from the context -- it is the magnitude of the effective rotation -- but the question is: What shall we call it? The basic quantity with which we are dealing, the rotational speed displacement, does not enter into the equations directly. The mathematical structure of these equations requires us to enter them with values that include the initial unit which constitutes the natural zero datum. Furthermore, each double vibrational unit rotates independently, and when the rotation extends to a second such unit the increment in the value of t is only one half unit per added unit of displacement. Under these circumstances, where the relation of the term t to the displacement is variable, it seems advisable to give this term a distinctive name, and we will therefore call in the specific rotation.

As brought out in the discussion of the general characteristics of the atomic rotation in Chapter 10, Vol. I, the two magnetic displaceements may be unequal, and in this event the speed distribution takes the form of a spheroid with the principal rotation effective in two dimensions and the subordinate rotation in one. The average effective value of the specific rotation under these conditions is $(t_1^2\ t_2^2)^{\frac{1}{3}}$. In this case we are dealing with the properties of a single entity, and the mathematical situation seems clear. But it is not so evident how we should arrive at the effective specific rotation where there is an interaction between two atoms whose individual rotations are different. As matters now stand it appears that the geometric mean of the two specific rotations is the correct quantity, and the values tabulated in Chapters 2 and 3 have been calculated on this basis. It should be noted, however, that this conclusion as to the mathematics of the combination is still somewhat tentative, and if further study shows that it must be modified in some, or all, applications, the calculated values will be subject to corresponding modifications. Any changes will be small in most cases, but they will be substantial where there is a large difference between the two components. The absence of major discrepancies between the calculated and observed distances in combinations of atoms with much different dimensions therefore gives some significant support to the use of the geometric mean pending further theoretical clarification.

The inter-atomic distances of four of the five inert gas elements for which experimental data are available follow the regular pattern. The values calculated for these elements are compared with the experimental distances in Table I. Helium, which also belongs to the inert gas series, has some special characteristics due to its low rotational displacement, and will be discussed in connection with other elements affected by the same factors. The reason for the appearance of the $4\frac{1}{2}$ value in the xenon rotation will also be explained shortly.

The calculated distances are those which would prevail in the absence of compression and thermal expansion. A few of the experimental data have been extrapolated to this zero base by the investigators, but most of them are the actual observed values at atmospheric pressure and at temperatures which depend on the properties of the substances under examination. These values are not exactly comparable to the calculated distances. In general, however, the expansion and compression up to the temperature and pressure of observation are small. A comparison of the values in the last two columns of Table I and the similar tables in chapters 2 and 3 therefore gives a good picture of the extent of agreement between the theoretical figures and the experimental results.

Another point about the distance correlations that needs to be taken into account is that there is a substantial amount of variation in the experimental results.

TABLE I

DISTANCES - INERT GAS ELEMENTS

Atomic Number	Element	Specific Rotation	Distance Calc.	Obs.
10	Neon	3-3	3.21	3.20
18	Argon	4-3	3.74	3.84
36	Krypton	4-4	4.04	4.02
54	Xenon	4 1/2-4 1/2	4.35	4.41

If we were to take the closest of these measured values as the basis for comparison, the correlation would be very much better. One relatively recent determination of the xenon distance, for example, arrives at a value of 4.34, almost identical with the calculated distance. There are also reported values for the argon distance that agree more closely with the theoretical result. However, a general policy of using the closest values would introduce a bias that would tend to make the correlation look more favorable than the situation actually warrants. It has therefore been considered advisable to use empirical data from a recognized selection of preferred values. Except for those values identified by asterisks, all of the experimental distances shown in the tables are taken from the extensive compilation by Wyckoff. [2] Of course, the use of these values selected on the basis of indirect criteria introduces a bias in the unfavorable direction, since, if the theoretical results are correct, every experimental error shows up as a discrepancy, but even with this negative bias the agreement between theory and observation is close enough to show that the theoretical determination of the inter-atomic distance is correct in principle, and to demonstrate that, with the exception of a relatively small number of uncertain cases, it is also correct in the detailed application.

Turning now to the elements which have electric as well as magnetic displacement, we note again that the electric rotation is one-dimensional and opposes the magnetic rotation. We may therefore obtain an expression for the effect of the electric rotational force on the magnetically rotating photon by inverting the one-dimensional force term of equation 1-2.

$$F_e = 1/(\ln t'_A \ln t'_B) \qquad \langle 1\text{-}8 \rangle$$

Inasmuch as the electric rotation is not an independent motion of the basic photon, but a rotation of the magnetically rotating structure in the reverse direction, combining the electric rotational force of equation 1-8 with the magnetic rotational force of equation 1-4 modifies the rotational terms (the functions of t) only, and leaves the remainder of equation 1-4 unchanged.

$$F = (0.006392)^4 [(\ln^2 t_A \ln^2 t_B)/(s^4 \ln t'_A \ln t'_B)] \quad <1\text{-}9>$$

Here again the effective rotational (outward) and natural reference system progression (inward) forces are necessarily equal at the equilibrium point. Since the force of the progression of the natural reference system is unity, we substitute this value for F in equation 1-9 and solve for s , the equilibrium distance, as before.

$$s_0 = 0.006392 [(\ln^{1/2} t_A \ln^{1/2} t_B)/(\ln^{1/4} t'_A \ln^{1/4} t'_B)] \quad <1\text{-}10>$$

Again simplifying for application to the elements, where A is generally equal to B,

$$s_0 = 0.006392 \ln t/\ln^{1/2} t' \quad <1\text{-}11>$$

In Angstrom units this becomes

$$s_0 = 2.914 \ln t/\ln^{1/2} t'_A \quad <1\text{-}12>$$

As already noted, when the rotation is extended to a second (double) vibrational unit, to vibration two, we may say, each added displacement unit adds only one half unit to the specific rotation. Inasmuch as 8 electric displacement units distributed three-dimensionally bring the rotation to a new zero point, and cause the rotational motion to revert to the translational status, the change to vibration two in the electric dimension must take place before the displacement reaches 8. Specific rotation 8 (displacement 7) is therefore followed by 8 , 9, 9 , etc. But the first effective rotational displacement unit is necessarily one-dimensional, and the linear equivalent of the 8-unit limit is 2 units. Thus this first unit has already reached the one-dimensional limit. The succeeding displacement units have the option of continuing on the one-dimensional basis and extending the rotation to vibration two rather than extending it into additional dimensions. The change to vibration two therefore may take place immediately after the first displacement unit. In this case specific rotation 2 (displacement 1) is followed by 2 1/2, 3, 3 1/2, etc. The lower value is commonly found where it first becomes possible; that is, displacement 2 normally corresponds to rotation 2 1/2 rather than 3. The next element may take the intermediate value 3 1/2, but

beyond this point the higher vibration one value normally prevails.

In the first edition it was indicated that the one or two vibrational diplacement units being rotated did not necessarily constitute the entire vibrational component of the basic photon, inasmuch as these one or two units are capable of being rotated independently of the remaining vibrational units, if any. Further consideration now leads to the conclusion that one or two units of a multi-unit photon frequency can, in fact, be set in rotation independently, as previously indicated, and that the original photon may have had an excess of vibrational units, but that in such an event the rotating portion of the photon begins moving inward, whereas the nonrotating portion continues moving outward by reason of the progression of the natural reference system. The two portions therefore separate, and the rotating portion retains no non-rotating vibrational component.

The general pattern of the magnetic rotational values is the same as that of the electric values. The tendency to substitute specific rotation 2 1/2 for 3 applies to the magnetic as well as to the electric rotation, and in the lower group combinations (both elements and compounds) that follow the regular electropositive pattern the specific magnetic rotations are usually 2 1/2 - 2 1/2 or 3 - 2 1/2, rather than 3-3. But the upper limit for specific magnetic rotation on a vibration one basis is 4 (three displacement units) instead of 8, as the two-dimensional rotation reaches the upper zero level at 4 displacement units. Rotation 4 1/2 therefore follows rotation 4 in the regular sequence, as we saw in the values given for xenon in Table I. It is possible to reach rotation 5 in one dimension, however, without bringing the magnetic rotation as a whole up to the 5 level, and 5-4 or 5 - 4 1/2 rotation ocurs in some elements either in lieu of, or in combination with, the 4 1/2 - 4 or 4 1/2 - 4 1/2 rotation.

* * *

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PHOTOIONIZATION AND PHOTOMAGNETIZATION

by Ronald W. Satz

Introduction: the Reciprocal System vs. Present Theory

Consider a group of atoms in an electric field and bombarded with ultraviolet photons or a group of atoms in a magnetic field and bombarded with radio photons. What happens? Two theories exist that can give an answer: Quantum Mechanics and the Reciprocal system. Both are quantized, but the first is a matter-structure theory, whereas the second is a motion-process theory. Quantum Mechanics considers atoms to consist of various subatoms which have intrinsic charge, magnetic moment, and angular momentum; the atom's charge, moment, and momentum are derived from that of its subatoms. The Reciprocal system views atoms as composed of two photons, each having rotational motion in three dimensions; the atom has no intrinsic electric charge or magnetic moment -- electric and magnetic effects result from additions of rotational vibratory motions to the base rotational motions.

Quantum Mechanics' explanation of electric ionization is that previously existing charged particles, the protons and electrons, are separated; the Reciprocal System's explanation is that the positive and negative charges are created in the process, and thus have no prior existence. Quantum Mechanics' explanation of the magnetic resonance experiments is that the experimenters have found intrinsic magnetic moments of nuclei; the Reciprocal System's explanation is that the experimenters have induced temporary magnetic charges in their material. Quantitative details of both theories will now be examined. (Full comprehension of this paper requires previous reading of two of D. B. Larson's books, Refs. 1 and 2, and one of my papers, Ref. 3.)

I. Photoionization

A. Subatoms

1. Present theory.

According to present thought, the electric charge is unanalyzable and undefined, except operationally. Either a particle has or does not have an intrinsic electric charge -- there is no possibility of ionizing an uncharged subatom.

Present photoelectric theory states that, upon absorption of a sufficiently energetic photon, a pre-existing charged electron is ejected from its atom to move in an external circuit. [4,5] The energy necessary to tear the electron loose is called the work function of the material. No

commonly accepted equation for the work function, based on Quantum Mechanics, exists.

2. Reciprocal System

For details of subatom and atom motions, see Refs. 1, 2, and 3. In the Reciprocal System, electric charge is not an intrinsic feature of a subatom; rather, charges may be created or destroyed, not necessarily in pairs, and thus charge conservation in a process does not always hold true. However, total motion displacement is conserved in each process.

As with all other phenomena in the Reciprocal system, electric charge is a motion, in this case a simple harmonic rotational vibration, as shown in Figure I.

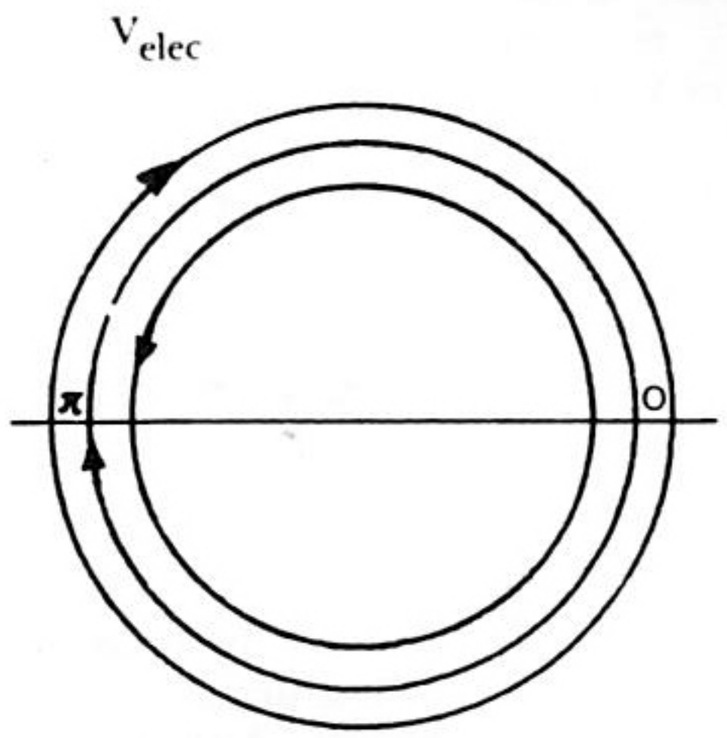

FIGURE I: ELECTRIC CHARGE

An equation for this motion will now be derived. Let θ be the rotation angle in radians, ν be its frequency in Hz, and t be the time in seconds. From the figure, the amplitude of the motion is π radians and the angular distance traveled each cycle is 4π radians. Hence the equation is

$$\theta = \pi \cos(4 \quad \nu t) \qquad <1>$$

As shown in a previous paper of mine [3], a negative electric charge has the frequency

$$\nu\text{-elec} = R/2\pi \qquad <2>$$

where R is the Rydberg frequency ($3.288 * 10^{15}$ Hz).

Electrons exist within matter, but not as intrinsic features of atoms. Also, these electrons are ordinarily uncharged. To travel outside of matter the electrons must become charged or ionized. The energy for the charge and the kinetic energy of the charged electron come from absorption of a photon, thus producing the photoelectric effect. A rigorous equation for this effect, slightly modified from Ref. 6, can now be given. Let

h = Planck's constant
ν_{phot} = photon frequency
v = electron velocity (outside of matter)
m = electron mass
eV = electric potential surrounding the matter
W_o = work function of the matter
U_k = energy of the electron before the process begins
U_ℓ = energy lost by charged electron in moving to surface

The equation for the electron's kinetic energy outside of matter is then

$$1/2\ mv^2 = h\nu_{phot} \pm eV - W_o + U_k - U_\ell \qquad <3>$$

According to the Reciprocal System the work function is the energy necessary to charge an uncharged electron. Since the rotational vibration is scalar, like the linear vibration, Planck's law holds for electric charges as well as for photons:

$$E_{I,e} = h\nu_{elec} = h * R/2\pi = 2.17\ eV \qquad <4>$$

(Note: any observed values of work function less than 2.17 eV imply previous electron energy, U_k). The value of $E_{I,e}$ given in <4> is modified by the environment of the electron, i.e., by the atom in which it currently exists. The electron's charge may be in the same dimension as one of the atom's magnetic rotations or in the same dimension as the electric rotation. In the Reciprocal system, charge is energy, t/s, the inverse of velocity. The atom's magnetic rotation velocity is v_{mag}, its electric rotation velocity is v_{elec}; the inverse of these in natural units is c/v_{mag} and c/v_{elec}, where c is the speed of light. If the atom has only one electric time displacement unit ($v_{elec} = (1/2)c$), the ionization energy of the electron is not increased, hence a 1 must be subtracted from c/v_{elec}. Finally, the atomic motions take place in the time region, whereas we want the energy as measured in the time-space region -- so the square root of the inverse velocity expressions must be taken. Thus

$$w_o = 2.17 * [c/v_{mag}]^{1/2}\ eV.$$

and/or <5a>

$$w_o = 2.17 * [c/v_{elec} - 1]^{1/2} \text{ eV}$$

These equations, theoretically derived, are nearly identical to the "empirical" equation given by Larson in Ref 1 (p. 118), eq. <142>). The set of values of W_o is

$$w_o = \{2.17, 3.07, 3.76, 4.34, 4.82\} \quad \text{<5b>}$$

Table I compares the theoretical results with those observed.

TABLE I

WORK FUNCTION AND IONIZATION ENERGY

			W_o		E_I	
Element	c/v_{mag}	c/v_{elec}	calc.	obs	calc.	obs.
Li		2	2.17	2.28	4.34	5.39
Be	3		3.76	3.92	7.52	9.32
B	4		3.76	4.4	7.52	8.296
C		5	4.34	4.341	8.68	11.264
Na		2	2.17	2.25	4.34	5.138
Mg	3		3.76	3.78	7.52	7.644
Al		4	3.76	3.43	7.52	5.984
Si		5	4.34	4.2	8.68	8.149
K		2	2.17	2.12	4.34	4.39
Ca		3	3.07	3.20	6.14	6.111
Ti	3		3.76	3.95	7.52	6.83
V	3		3.76	3.95	7.52	6.83
Cr	4		4.34	4.37	8.68	6.764
Mn	3		3.76	3.76	7.52	7.432
Fe	3		3.76	3.91	7.52	7.90
Co	3		3.76	3.9	7.52	7.86
Ni	3		3.76	3.67	7.52	7.633
Cu	3		3.76	3.85	7.52	7.724
Zn	3		3.76	3.89	7.52	9.391
Ga		4	3.76	3.80	7.52	6.00
Ge		5	4.34	4.29	8.68	7.88
As		6	4.82	5.11	9.64	9.81
Se	4		4.34	4.42	8.68	9.75
Rb		2	2.17	2.16	4.34	4.176
Sr		3	3.07	2.74	6.14	5.692
Zr	3		3.76	3.73	7.52	6.835
Nb	3		3.76	3.96	7.52	6.88
Mo	3		3.76	4.08	7.52	7.131
Ru	4		4.34	4.52	8.68	7.36
Rh	4		4.34	4.57	8.68	7.46
Pd	4		4.34	4.49	8.68	8.33
As	4		4.34	4.33	8.68	7.574
Cd	3		3.76	3.73	7.52	8.991

Sn	3		3.76	3.62	7.52	7.332
Sb	4		4.34	4.14	8.68	8.64
Te	4		4.34	4.70	8.68	9.09
Cs		2	2.17	1.96	4.34	3.893
Ba*		2	2.17	2.11	4.34	5.810
La*	2		3.07	3.3	6.14	5.61
Ce*	2		3.07	2.84	6.14	6.91
Pr*	2		3.07	2.7	6.14	5.76
Nd*	2		3.07	3.3	6.14	6.31
Sm*	2		3.07	3.2	6.14	5.6
Hf*	2		3.07	3.53	6.14	5.5
Ta	3		3.76	3.96	7.52	7.7
W	4		4.34	4.35	8.68	7.98
Re	4		4.34	5.0	8.68	7.87
Os	4		4.34	4.55	8.68	8.7
Ir	4		4.34	4.5	8.68	9.2
Pt	4		4.34	4.09	8.68	8.96
Au	4		4.34	4.46	8.68	9.223
Hg	4		4.34	4.5	8.68	10.434
Tl	3		3.76	3.84	7.52	6.106
Pb	3		3.76	3.94	7.52	7.415
Bi	4		4.34	4.31	8.68	7.287

The agreement is excellent (the correlation coefficient r_{corr} = .964).

As discussed by Ref. 7, the number of electrons emitted per incident photon depends on both the nature of the emitter and the frequency of the incident radiation. At frequencies lower than that at which maximum yield is obtained, reflectivity of incident photons is so high that only a few photons take part in the emission process. At frequencies higher than that at which maximum yield is obtained, the photons penetrate to such a depth that the electrons, newly charged at that depth, lose too much energy in coming to the surface.

Of the remaining subatoms only the positron, proton and H^1 can take an electric charge. As shown in Ref 3, a positive electric charge has the frequency

$$\nu_{+elec} = 2R/\pi \qquad <6>$$

---

*Asterisk denotes entry of rotation into second space-time unit in the 4A and 4B groups; also where value 3 appears in magnetic rotation, this is the inverse of actual rotation. Values of c/v_{mag}, c/v_{elec}, and W_o obs. are taken from Table CIX of Ref. 1.

The ionization energy of a free positron or proton (not including force-coupling effects) is then

$$E_{I,p} = h\nu_{+elec} = h * 2R/\pi = 8.68 \text{ eV} \quad \langle 7 \rangle$$

Now consider the ionization of the intermediate particle, H^1. Here everything is unity: H has one natural unit of primary mass and one unit of electric space displacement; one positive charge is created and one negative charge. So the required photon energy must also be unity by the Principle of Equivalence (see Ref. 1, p. 21):

$$E_{I,H\ 1} = h * R = 13.595 \text{ eV} \quad \langle 8 \rangle$$

as observed.

B. Atoms

1. Present Theory

In present theory, ionization is thought to be the ejection of an electron from its orbital, leaving a net positive charge on the atom. No generally accepted equation has been developed to calculate the energy of ionization from Quantum Mechanics. One might expect the ionization energy to be practically the same as the work function -- but it is not. Indeed, there is no evidence that matter becomes ionized in the photoelectric effect.

Gas and liquid ionization is currently thought to be the break-up of previously existing oppositely-charged units.

2. Reciprocal System

In the photoelectric effect, only charged electrons are created, not charged atoms. But generally in atomic ionization both positive and negative electric charges are created (they do not exist previously). Where negative ions can form, as with the electronegative elements, they do so. But usually negatively-charged electrons serve as the second component of the force couple creating the charges. Thus in most cases a positively-charged ion and a negatively-charged electron are the results of ionization. So, rather than the ionization energy being the binding energy of an electron to a nucleus, it is the energy required to create two charges, one positive and one negative.

Equation <5> gave the energy necessary to create a negative charge on an electron. From mechanical considerations it is obvious that the energy necessary to create a positive-negative charge pair is twice that needed

to create the negative charge on the electron. Hence for the first ionization level the energy is

$$E_{I,atom} = 4.34 * [c/v_{mag}]^{1/2} \text{ ev}$$
$$E_{I,atom} = 4.34 * [c/v_{elec}-1]^{1/2} \text{ ev} \quad \text{<9a>}$$

The set of values of $E_{I,atom}$ is

$$E_{I,atom} = \{4.34, 6.14, 7.52, 8.68, 9.64\} \quad \text{<9b>}$$

Table I compares calculated values with observed values of ionization [8]. Agreement is very good. (Avg. W_o calc. = 3.706; avg. W_o obs.=3.779. Avg. E_I calc. =7.412; avg. E_I obs=7.366. Avg. E_I calc./avg. W_o calc.=2.000; avg. E_I obs./avg. W_o obs.=1.95. For E_I obs. and $E_I$calc. r_{corr}=.803. Individual discrepancies are most likely due to experimental error.)

Ordinarily, solids are not ionized; the resulting forces would overcome the cohesive energy and break apart the solid. Liquids and gases are more readily ionized, with the energy often being supplied by photons. An electric field is of course necessary to prevent the charges from recombining. For a good discussion of liquid ionization, see Ref. 1.

Gaseous ionization depends on both electric field strength and gas pressure. An equation for the saturation electric field will now be derived. Let

I = primary current (ions created by photons/time)

E_{phot}/t = photon energy absorbed per unit time

E_I = ionization energy

$\mathcal{E}_f$ = electric field strength

$\mathcal{E}_{fnat}$ = natural unit of electric field strength

P = gas pressure; P_{nat} = natural unit of pressure

The equation for the primary ion current is then

$$I = (E_{phot}/t) * (1/E_I) * (\mathcal{E}_f/\mathcal{E}_{fnat}) * (P_{nat}/P) \quad \text{<10>}$$

Clearly if $E_{phot} = E_I$, $\mathcal{E}_f = \mathcal{E}_f$ nat., and $P = P_{nat}$, one ion

per time t will be created. For a fixed energy input, I can be increased either by increasing $\mathscr{E}_f$ or decreasing P until

$$(\mathscr{E}_f / \mathscr{E}_{fnat}) * (P_{nat}/P) = 1 \qquad \text{<11a>}$$

Solving for $\mathscr{E}_f$ we have

$$\mathscr{E}_f = \mathscr{E}_{fnat} * (P/P_{nat}) \qquad \text{<11b>}$$

With $\mathscr{E}_{fnat} = 2.04133 * 10^{16}$ v/m and $P_{nat} = 1.5539 * 10^{7}$ atm., and letting $P = 1 * 10^{-5}$ atm., then

$$\mathscr{E}_{fsaturated} = 13137 \text{ v/m}$$

The newly created ions and charged electrons can themselves cause further ionization, which is called secondary ionization.

The reverse of ionization is the addition of a negatively charged electron to a singly charged positive ion, which results in a neutral atom. Thus the "electron affinity" of a singly charged positive ion is just the negative of the ionization energy of the corresponding neutral atom.[9] Where current theory gets into difficulty is in understanding the "electron affinity" of neutral atoms. According to the Reciprocal System, the electron loses its charge upon absorption in matter, resulting in a reverse photoelectric effect.

II. Photomagnetization

A. Subatoms

1. Present Theory

According to present thought, the magnetic resonance experiments detect the magnetic moments intrinsic to subatoms and atoms (nuclei). The magnetic moment is considered to result from the angular spin of the electric charge of a particle. It is given in units of the Bohr magneton or the nuclear magneton, as derived from Dirac's theory.

A number of problems exist with this theory. The neutron has a magnetic moment, but no electric charge. Pions and alpha particles do have electric charges but no magnetic moment; present theory claims that these particles have zero spin -- but that seems equally strange. The magnetic moment of the proton has been obtained from experiments with ice and water; thus the magnetic moment could actually be that of H

itself, regardless of what theory says. The magnetic moment of the anti-proton has been found not to equal the magnetic moment of the proton (or rather, H^1).

More fundamentally, the value of the magnetic moment is not measured directly; it is inferred from the data. To see this, let

ν_o = resonant photon frequency
$h\nu_o$ = absorbed photon energy
B = magnetic field strength
μ = magnetic moment in field direction
L = angular spin no.

The equation (from Ref. 10) is

$$h\nu_o = [\mu/L] * B \qquad <12>$$

The energy $h\nu_o$ and field B are measured, L is inferred from other data (usually spectroscopic), and then μ is calculated. If L is bogus, then μ is bogus. All that the experiments tell us is that for a given B there exists a certain photon frequency at which great amounts of energy are absorbed by the sub-atoms and atoms. The conclusion that the relation between $h\nu_o$ and B is μ/L is purely hypothetical.

2. Reciprocal System

My interpretation of the magnetic resonance experiments, on the basis of the Reciprocal System, is radically different. Here the sub-atoms and atoms have no intrinsic magnetic moments or magnetic charges. (Note: the isotopic charges in atoms cancel the magnetic effect of the magnetic charges of the neutrinos contained within). But under certain circumstances, such as in the magnetic resonance experiments, temporary magnetic charges can be induced. A magnetic charge is a rotational vibration of one of the inner magnetic rotations of the sub-atom or atom.

As given in Ref. 3, the vibrational frequency of a unit magnetic charge is

$$\nu_{mag} = 2R/\pi \qquad <13>$$

The required energy to produce this vibration depends on the environment: the magnetic field and the velocity of the principal or subordinate magnetic rotation which is modified by the charge. The resulting equation is related to, but different from, the equation for energy of electric ionization, eq. <5>. In the Reciprocal system, magnetic effects are the square of electric effects -- so the square root of eq. <5> is eliminated. Also, as in the equations for

force and distance in the Reciprocal System, the effect of the magnetic velocity is inverse to that of the electric velocity. Thus, instead of the energy being proportional to $\sqrt{c/v_{mag.}}$ the energy is proportional to v_{mag}/c. The complete expression is

$$h\nu_o = [h * (2R/\pi * (v_{mag}/c) * 1/B_{nat}] * B \qquad <14a>$$

Larson [1] has previously identified magnetic susceptibility as proportional to v_{mag}/c. This provides additional support for that term in the above equation.

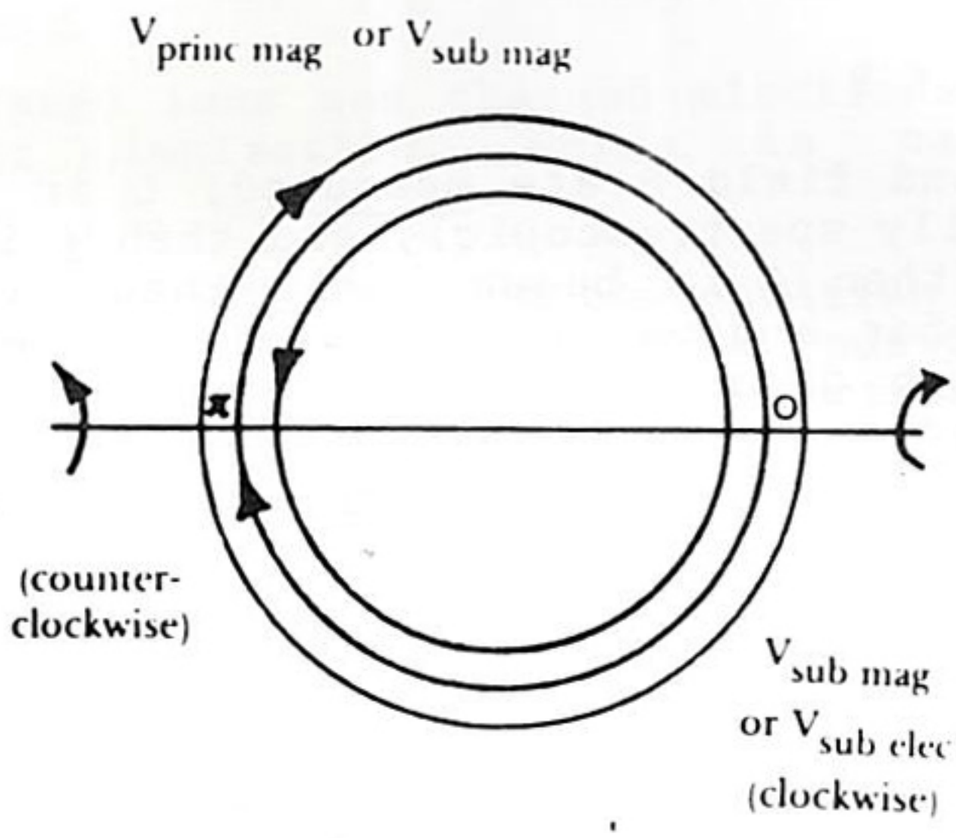

FIGURE II: MAGNETIC CHARGE

As shown in Figure II, the sole difference between a magnetic charge and an electric charge is that the magnetic charge is an electric charge that is given an extra angular spin by either the subordinate magnetic rotation or the electric rotation (depending on whether the charge is placed on the principal or subordinate magnetic rotation).

If no magnetic field is present, and the photons are not reflected, the photon energy is simply transformed to thermal energy of the particle. For a given magnetic field B, ν_o can be calculated for each kind of sub-atom and atom. As discussed in Ref. 3, v_{mag}/c can take on the following values:

$$v_{mag}/c = \{.20, .22, .25, .29, .33, .40, .50\} \qquad <14b>$$

Setting B equal to 1 Tesla and knowing that $B_{nat} = 6.813*10^7$

Tesla, the following resonance frequencies are obtained:

$$\nu_o \text{ in MHz} = \{6.14, 6.83, 7.68, 8.78, 10.24, 12.29, 15.36\} \quad \langle 14c \rangle$$

The calculation assumes that no other energy is present that can be utilized in the creation of the magnetic charge. Unfortunately, magnetic resonance experiments have been done at room temperature rather than at temperatures close to 0 degrees K, so the absorption of thermal energy is a definite possibility.

Nearly all atoms have magnetic resonance frequencies at or below 15.6 MHz (with B = 1 Tesla), in accord with eq. (14). But the intermediate particles, the neutron and H^1, have higher observed frequencies, 29.16 MHz and 42.57 MHz, respectively. One theoretical explanation is that these particles require multiple magnetic charges if they are to have any at all. The neutron is comprised of two rotational systems: a proton rotational system and a cosmic neutrino rotational system. In terms of total rotational speed (in natural units) the notation is

$$\text{neutron} \begin{cases} 1/3 - 1/2 \\ 2 - 2 \end{cases} \searrow \swarrow 1$$

(See Refs. 1 and 3 for details). Suppose each rotational system takes a magnetic charge on its subordinate magnetic rotation. For the proton rotational system, the energy required is

$$h * (2R/\pi) * (1/2) * (B/B_{nat})$$

For the cosmic neutrino rotation (which takes an inverse charge) the energy required is

$$h * (2R/\pi) * 2 * (B/B_{nat})$$

The combined energy is

$$h * (2R/\pi) * (B/B_{nat})$$

and the resonance frequency is 30.70 MHz (for B and B_{nat} as before). The small discrepancy between the observed and calculated values may be due to the absorption of thermal energy.

The notation for H^1 is

$$H^1 \quad \left\{ \begin{matrix} 1/3 - 1/2 \\ 1/2 - 1/2 \end{matrix} \right\} 2$$

In this case, though, each rotational system apparently takes two charges, so that the frequency is $3R/\pi$ rather than $2R/\pi$. The energy required is then

$$[h * (3R/\pi) * (1/2) + h * (3R/\pi) * (1/2)] * (B/B_{nat})$$

giving a resonance frequency of 46.05 MHz. Again the discrepancy between that observed and that calculated may be due to the utilization of thermal energy.

Both the real proton and anti-proton (inverse proton) and the material and cosmic neutrinos and the material and cosmic massless neutrons should have resonance frequencies of 15.36 MHz, unless they take multiple charges.

The electron and positron have no subordinate magnetic displacements at all and thus cannot take magnetic charges. All magnetic effects of these particles (and also the muon), whether uncharged or charged, result from their being in translational motion. To quote Larson [2]:

> As we have seen, the electric charge is a one-dimensional modification of the rotational motion of an atom or sub-atomic particle and the magnetic charge is a similar two-dimensional modification. The characteristic effects of the magnetic charge originate because the one-dimensional forces are distributed over two dimensions by the second rotation. But for this purpose it is not necessary that the motion in the second dimension be rotational. We can see why this is true if we examined the behavior of the axes of rotation. The axis of the electric rotation of an atom is a line: a one-dimensional figure. A stationary electric charge thus has no two-dimensional rotational effects. For a magnetic charge the locus of all positions of either axis is a disk: a two-dimensional figure and the magnetic charge has two-dimensional properties. But if we move the electric charge translationally, the locus of all positions of the axis is again a two-dimensional figure, and hence a moving electric charge has a two-dimensional distribution of forces comparable to that of a magnetic charge. . . . If an uncharged electron or positron is given a translational motion, this again is motion in two dimensions and it produces electromagnetism, a magnetic effect.

Particles heavier than the electron and positron would show a

similar magnetic effect <u>if</u> they could be accelerated to the same high velocities.

B. Atoms

1. Present Theory

Present theory regards the magnetic moment of nuclei to result from a combination of the moments of its constituent sub-atoms. Even-even nuclei are regarded as having zero net spin and thus zero moment. According to Segre's account of current theory [11], adding a neutron to an even-even nucleus is supposed to yield $(\ell + 1/2)[-3.826/(2\ell + 1)]$ nuclear magnetons for the magnetic moment, where ℓ is the spin angular momentum of the added neutron; subtracting a neutron is supposed to yield $(\ell - 1/2)[3.826/(2\ell + 1)]$ nuclear magnetons. Adding a proton is supposed to yield $(\ell + 1/2)[1 + 4.586/(2\ell + 1)]$ nuclear magnetons, whereas subtracting a proton is supposed to yield $(\ell - 1/2)[1-4.586/(2\ell + 1)]$ nuclear magnetons. These expressions do bracket the data, as Segre points out, but that is all: they do not work in detailed application.

The sign given for the moment is an <u>inference</u>, not a result from experiment (which measures only photon energy and magnetic field strength at resonance). In present theory, both the magnetic moment and angular spin are vectors. If they are aligned the magnetic moment is said to be positive; if anti-aligned, negative.

2. Reciprocal System

In the Reciprocal System all basic motions -- including the electric and magnetic charges -- are scalar. In addition, the magnetic charge is intrinsically dipolar: the magnetic rotation of the one-dimensional rotational vibration can be viewed both clockwise and counter-clockwise (see Figure 2). Generally in the magnetic resonance experiments, the atoms are induced to take only a single magnetic charge and thus have resonance frequencies of 15.36 MHz or less. The exceptions, such as F and Tl, are apparently induced to take multiple charges.

Table II compares the observed resonance frequencies [12] (of stable isotopes) with the theoretical results from eq. <14>. (Note: Thermal energy and cohesive energy are not taken into account; numerous isotopes (usually unstable) given in Ref. 12 have resonance frequencies less than 6.14 MHz -- these are not given in the table below. Further theoretical work is necessary to include thermal energy, cohesive energy, and instability effects in magnetic resonance).

TABLE II

MAGNETIC RESONANCE FREQUENCIES

Isotope	Displ.	v_{mag}/c Mag. Speed	[B=1 Tesla] ν_{calc} (MHz)	ν_{obs} (MHz)
$_{5}B^{11}$	2-2-3	1/2	15.36	13.66
$_{21}Sc^{45}$	3-2-3	1/3	10.24	10.36
$_{25}Mn^{55}$	3-2-7	1/3	10.24	10.57
$_{27}Co^{59}$	3-2-9	1/3	10.24	10.12
$_{29}Cu^{61}$	3-3-(7)	1/3	10.24	10.12
$_{31}Ga^{69}$	3-3-(5)	1/3	10.24	10.24
$_{33}As^{75}$	3-3-(3)	1/4	7.68	7.31
$_{34}Se^{77}$	3-3-(2)	2/7	8.78	8.14
$_{35}Br^{79}$	3-3-(1)	1/3	10.24	10.70
$_{41}Nb^{93}$	3-3-5	1/3	10.24	10.45
$_{47}Ag^{104}$	4-3-(7)	1/5	6.14	6.10
$_{48}Cd^{111}$	4-3-(6)	2/7	8.78	9.07
$_{49}In^{113}$	4-3-(5)	2/7	8.78	9.35
$_{51}Sb^{121}$	4-3-(3)	1/3	10.24	10.24
$_{63}Eu^{151}$	4-3-9	1/3	10.24	10.56
$_{65}Tb^{159}$	4-3-11	2/7	8.78	8.64
$_{67}Ho^{165}$	4-3-13	2/7	8.78	8.93
$_{70}Yb^{171}$	4-3-16	1/4	7.68	7.52
$_{73}Ta^{181}$	4-4-(13)	1/5	6.14	5.14
$_{78}Pt^{195}$	4-4-(8)	2/7	8.78	9.24
$_{82}Pb^{207}$	4-4-(4)	2/7	8.78	8.99

The equation appears to work well for the majority of atoms studied (r_{corr} = .956 for the table). In those cases where the equation does poorly, the thermal effects may be the culprit. Ideally, the experiments should be repeated with the atoms widely separated and at close to 0 K in temperature -- then the effects of thermal energy and cohesive energy would be eliminated. Under such conditions all frequencies for the induction of a single unit of magnetic charge in a stable isotope should be between 6.14 MHz and 15.36 MHz when the field B is 1 Tesla.

Atoms with an even number of neutrino-induced isotopic charges (half on each rotational system) have no need to acquire another charge for balance. Hence in the current jargon these atoms do not have a 'magnetic moment.'

In the series of isotopes of an element, the placement of the magnetic charge appears to alternate with the placement of the isotopic charge. A quantitative check on this is difficult to do because in most such series there are unstable isotopes -- this instability adds another variable to the problem. Apparently if the number of isotopic charges is greater than that allowed by the magnetic ionization level, the energy required to induce a magnetic charge is decreased. Once the magnetic field is turned off and the photon bombardment ceases, the magnetic charges are transformed to radio photons and lost. Only a few elements, such as Co, Ni, and Fe, are able to retain a magnetic charge.

Summary. Electric and magnetic charges are not unanalyzable; they are one and two-dimensional rotational vibrations of a sub-atom or atom. They are also not permanent and inviolate; they may be created or destroyed, so long as overall motion displacement is conserved.

1a. The work function of a material is not the energy required to remove the least tightly bound electron; it is the energy required to charge an uncharged electron in that material.

1b. The ionization energy of an atom is not the energy required to separate pre-existing charged protons and electrons; it is the energy required to create a negative charge (on an electron) and a positive charge (on an atom) and is equal to twice the work function.

2. The magnetic resonance energy of a sub-atom or atom does not indicate a previously existing intrinsic magnetic moment; it is the energy required to induce one or more dipolar magnetic charges in sub-atoms or atoms.

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ARE COSMIC RAY PROTONS PRIMARY?

by Frank H. Meyer

It is not generally known that the answer of the Reciprocal System of physics to this question is definitely no. This answer was published in 1959 by Dewey B. Larson in his book The Structure of the Physical Universe, pp. 196-197, and again in 1965 in his book New Light on Space and Time, pp. 210-211 among other examples.

The primary particle of cosmic rays, according to the Reciprocal System, is a particle of the cosmic sector, the cosmic proton, the so-called anti-proton, not a particle of the material sector, the proton. The latter is a particle into which the cosmic proton is transformed when it crosses over from the cosmic sector (with speed in excess of unit speed c) to the material sector (with speed less than unit speed c).

The consensus of opinion among astrophysicists involved in cosmic ray studies has been that the answer to the above question is yes. This follows from their unconfirmed conjecture that cosmic rays must be an emanation from somewhere in the material sector: the Sun, the Milky Way, or other galactic nebulae, supernovae, etc. Bruno Rossi, a cosmic ray physicist, wrote in 1953: "Outside the earth's atmosphere cosmic radiation consists mainly of protons (nuclei of hydrogen), varying widely in energy." (Scientific American, September, 1953, p. 64). This view has persisted in the absence of knowledge about the Reciprocal System and in spite of much positive evidence incompatible with support for the conjecture.

Recently the hypothesis that the cosmic ray proton is the primary ray particle has received a quite negative blow from an inquiry by Andrew Buffington and Stephen M. Schindler, published in The Astrophysical Journal, 247:L105-109, 1981, August 1, with the title: "Recent Cosmic-Ray Antiproton Measurements and Astrophysical Implications." A main conclusion of this paper is that: "In summary, a primary anti-proton hypothesis cannot be ruled out." This inquiry also was reported in Science News, October 3, 1981, p. 233 under the title: "Are Cosmic Ray Antiprotons Primary?" The Reciprocal System answers yes; heretofore the prevailing view has implied that the answer should rather be no.

THE SEVENTH ANNUAL CONVENTION

OF THE INTERNATIONAL SOCIETY OF UNIFIED SCIENCE

As was agreed at last year's meeting, the 1982 convention will be held in Philadelphia. The dates selected are August 12, 13 and 14. The Alumni Hall in the Towne Building (220 South 33rd Street) has been reserved for the three days of the convention between the hours 9am and 5pm.

The organizers have reserved twenty rooms at the Holiday Inn for ISUS members. The cost is $54.00/night for a double room. As an alternative for members who want to defray costs the organizers recommend the Divine Tracy Hotel (20 South 36th Street, Philadelphia, PA 19104, tel. 215-382-4310). Prices range from ca. $10.00/night per person, based on double occupancy, to $14.00/night for singles. Interested members should make their own reservations at the Divine Tracy.

Any questions should be addressed to Brad Elkin, 543 South Melville Street, Philadelphia, PA 19143, tel. 215-386-8632.

Dewey B. Larson's new book The Neglected Facts of Modern Science is scheduled for publication in May. Orders may be sent to North Pacific Publishers, Box 13255, Portland, Oregon 97213. The cost is $9.00 for hardcover; $7.50 for softcover, postpaid.

Annual subscription to Reciprocity is $5.00. Single issues: $1.50. Reciprocity is sent free to members of the International Society of Unified Science. Annual ISUS dues of $15.00 also entitle members to attend and vote at the Society's annual conventions.